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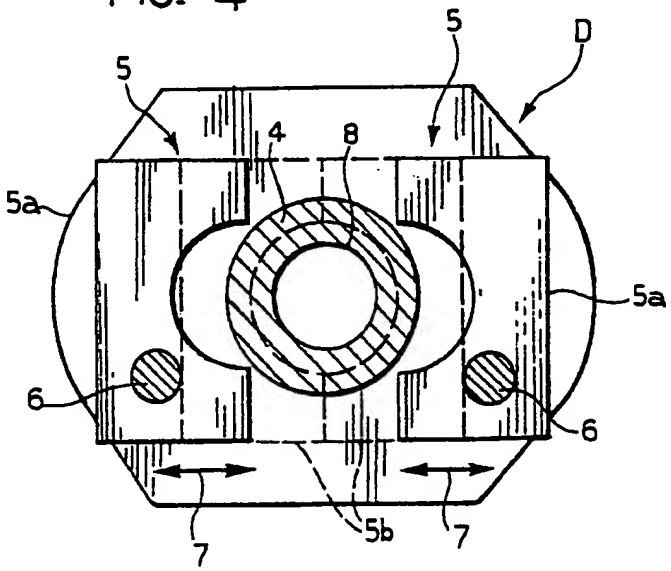
(54) Extruding hoses of variable diameter

(57) An extruder device (D) produces hoses (T, Figure 2) having portions (P) of increased thickness for protective purposes, for installation in the engine compartments of vehicles. This device (D) comprises movable obturators (5), the positions of which define the outside diameter of the hose (T). With the obturators in the position 5b (see dotted lines) the external diameter of the extruded hose is smaller than when the obturators are in the position 5a. When the obturators are in the position 5b, material may also be extruded through apertures 6 so as to prevent increase in pressure within the extruder. Several embodiments of obturators are disclosed.

FIG. 4



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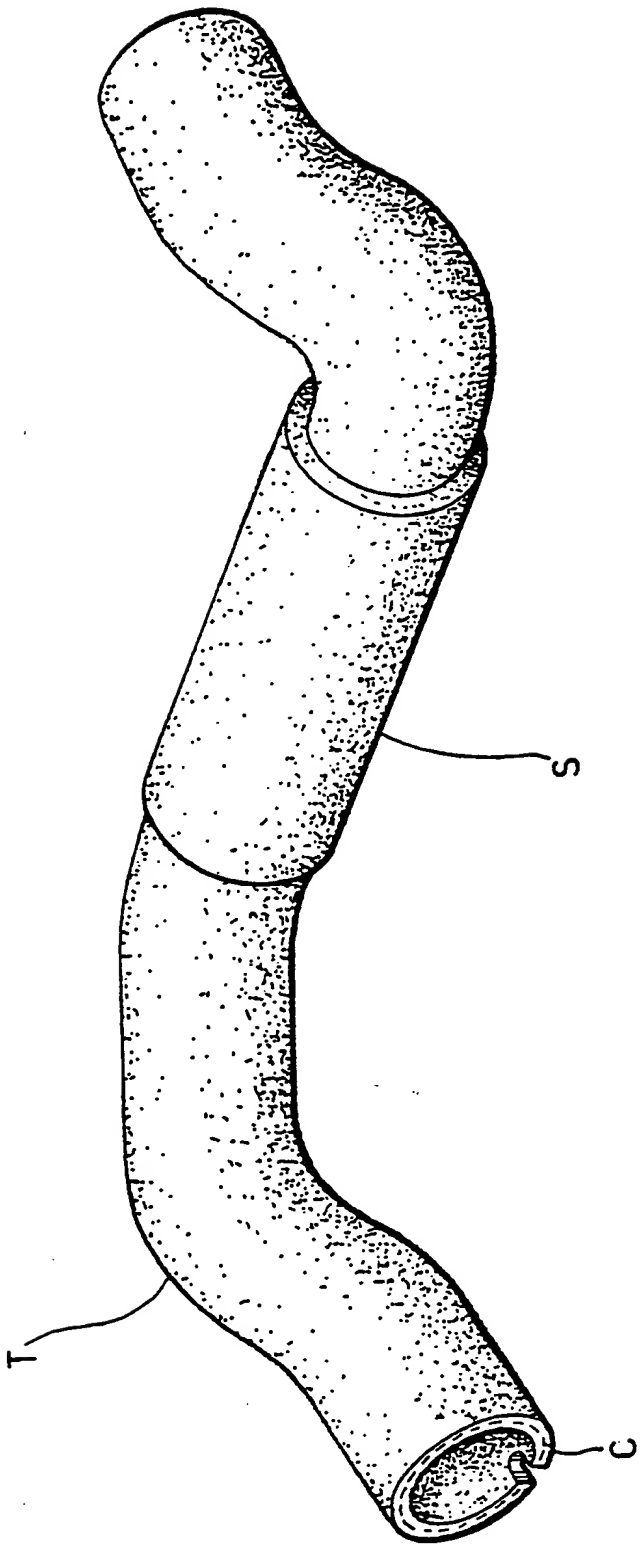


FIG. 1

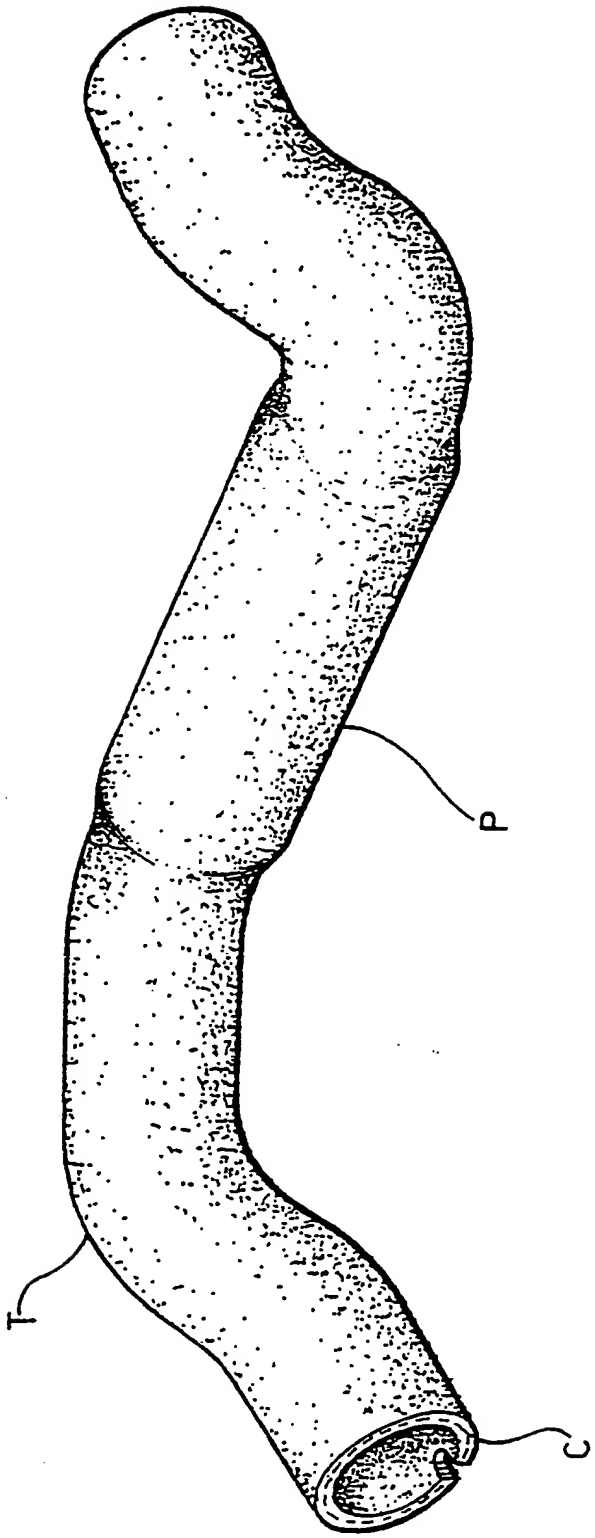


FIG. 2

FIG. 3

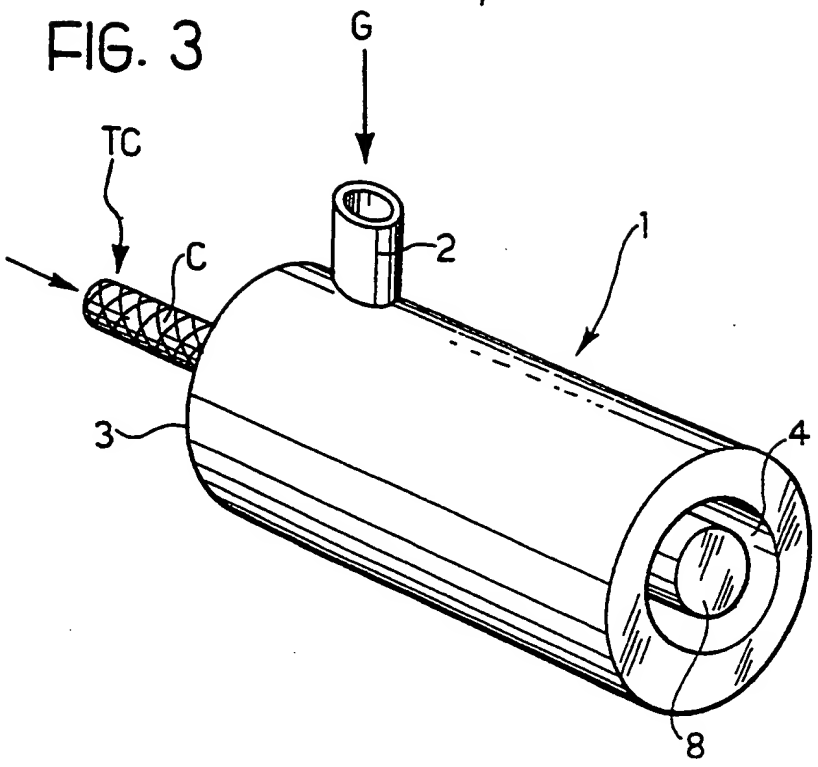


FIG. 4

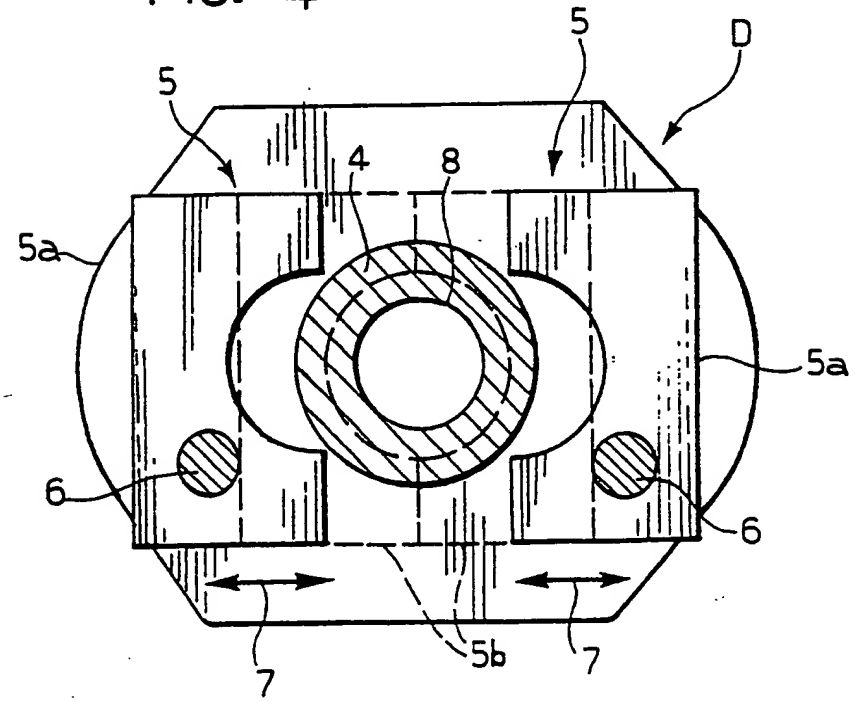


FIG. 5

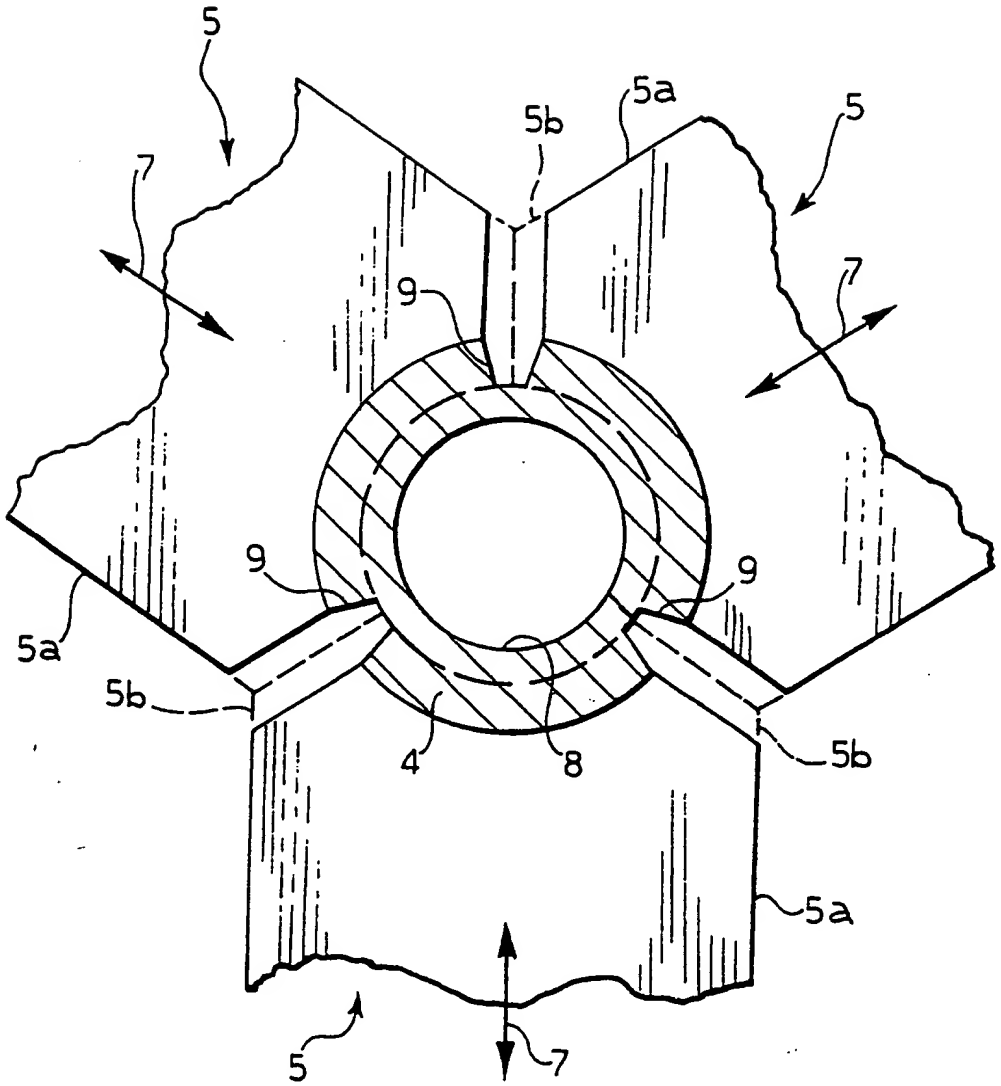
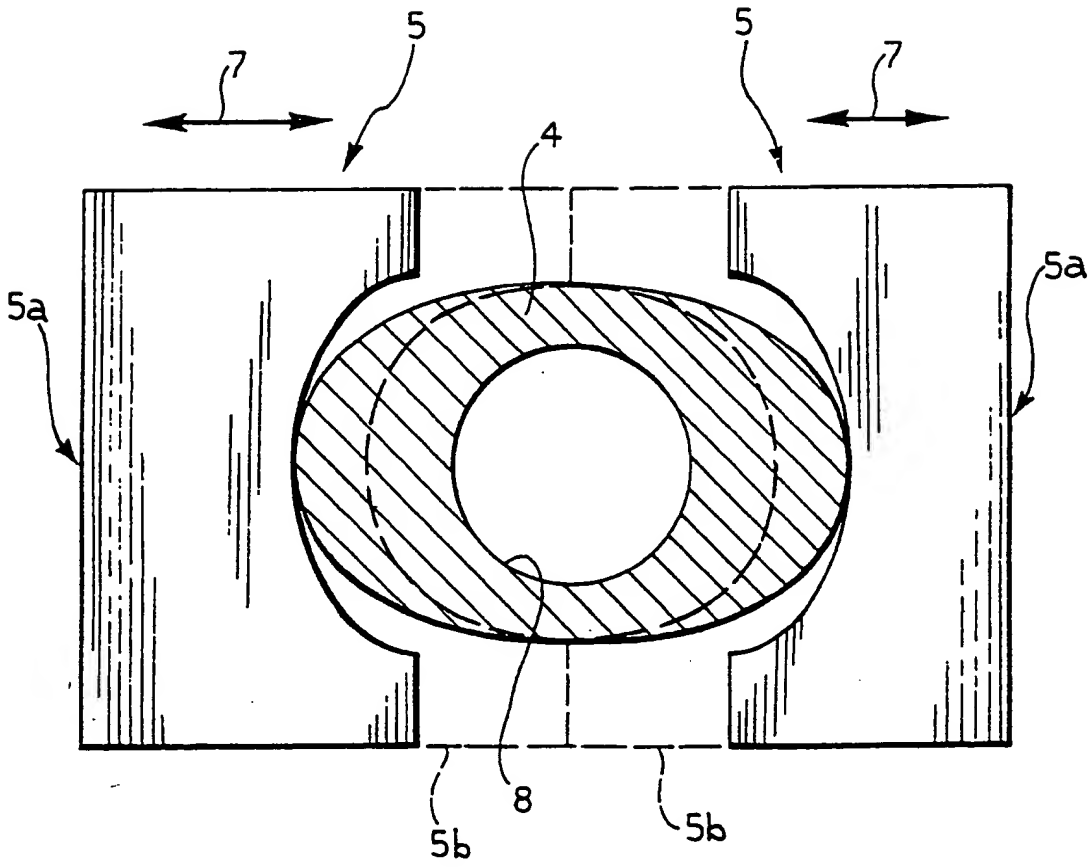


FIG. 6



A METHOD AND A DEVICE FOR PRODUCING CONNECTING HOSES AND A HOSE THUS PRODUCED

The present invention relates in general to devices for producing hoses and, more specifically, relates to a device and a method for producing rubber hoses for installation in the engine compartments of motor vehicles. A further subject of the invention is a hose thus produced.

As is known, there are numerous connecting hoses such as, for example, the coolant-, fuel-, lubricant-circulation hoses, in the engine compartment of a motor vehicle having an internal combustion engine.

These hoses are typically made of plastics or elastomeric material, for example, of rubber. They may be reinforced, that is, they may have a fabric stocking inserted in the wall of the hose, and are normally produced by extrusion. After extrusion, the hose which, at this stage is still plastic and deformable, is formed, that is bent, to cause it to adopt the desired shape. Once formed, the hose is treated to make it elastic so that it retains the shape imparted to it. Rubber hoses, for example, are vulcanized.

There is a tendency, particularly in recent times, to reduce the outside dimensions of motor vehicles, and particularly motor cars, to an ever greater extent whilst keeping unchanged or even improving internal comfort. Amongst other things, this decreases the space available for the engine compartment.

The space in the engine compartment is consequently almost completely taken up by the engine and by the

other mechanical members contained therein. For these reasons, the empty space available for the connecting hoses becomes ever smaller and the hoses also have to be shaped, sometimes with twisted profiles and very short radii of curvature, in order to be able to fit the available spaces and routes.

They therefore extend very close to or in contact with the engine and other mechanical members. Since violent vibrations are produced when the vehicle is in motion or when the engine is running, the hoses may be damaged or worn by abrasion against the mechanical members. Some of these members, for example, the engine and the exhaust manifolds, are very hot and the vibrations may bring hoses extending near these members nearer to them or into contact with them, or may wear hoses which are already in contact with them.

The hoses therefore need protection when they are exposed to the aforementioned risks of damage.

It is known in the art to fit protective hoses or sleeves also made of plastics or elastomeric materials such as, for example EPDM, PVC, polyolefinic resin, neoprene, etc., on the hoses in order to protect the exposed portions of the hose from heat or abrasion.

For a better understanding, Figure 1 shows a connecting hose T of reinforced rubber C, onto which a protective sleeve P has been fitted. This protection technique, however, has various disadvantages.

The operation of fitting a sleeve over the hose is quite difficult since, as has been stated, connecting hoses adopt ever more twisted shapes and ever tighter

radii of curvature, and also because the protective sleeve has to be fitted tightly so that it does not move once it is in the desired position.

In order to carry out this operation, typically, it is necessary to straighten out the hose, for example, by fitting a straight metal pipe inside it, before the protective hose can be fitted thereon. If the protective sleeve is wider to enable it to be fitted more easily, however, it is necessary subsequently to fix it in the desired position, for example, by adhesives or clamping clips which thus involves an additional operation and additional costs.

The object of the present invention is to provide a device and a method of producing hoses which solve all the problems indicated above in a satisfactory manner.

According to the present invention, this object is achieved by virtue of a device and a method having the characteristics indicated in the claims which follow the present description.

Further advantages and characteristics of the present invention will become clear from the following detailed description, given with the aid of the appended drawings, provided by way of non-limiting example, in which:

Figure 1 shows a connecting hose with a protection device according to the prior art, and has already been described,

Figure 2 shows a connecting hose produced by the device according to the present invention,

Figure 3 shows schematically a device for producing hoses according to the prior art,

Figure 4 shows schematically a device for producing hoses according to the present invention,

Figure 5 shows schematically an alternative embodiment of the device of Figure 4,

Figure 6 shows schematically a further alternative embodiment of the device of Figure 4.

The present invention consists essentially of a device for producing connecting hoses of differentiated wall-thickness. The device enables the aforesaid hoses to be produced in a single extrusion step.

For a better understanding, a device according to the prior art for extruding reinforced rubber hoses will now be described with reference to Figure 3.

The device 1 has an inlet 2 through which the rubber G is introduced in the plastic state. A rubber hose TC is introduced, also in the plastic state and covered by a fabric stocking C, from a second inlet disposed in the rear region 3 of the device 1. In the front portion of the device 1 there is an annular opening 4 referred to below as the extrusion aperture. The rubber G is subjected to pressure within the device 1 causing it to emerge from the extrusion aperture 4.

The annular shape of the aperture 4 results in the extrusion of a cylindrical rubber hose therefrom. The outside diameter of the extrusion aperture 4 defines the size of the extruded hose, and the diameter of a

central body 8 consequently defines the wall thickness of the extruded hose, by difference.

The fabric stocking C is inserted within the wall of the extruded hose.

After the reinforced rubber hose has been extruded, it is cut to the desired lengths to produce connecting hoses. The desired shape is imparted to the portions of hose thus cut, as already stated. The last stage of the method consists of the vulcanization of the hoses so that the rubber G of which they are formed changes from the plastic state to the elastic state, thus enabling the hoses to retain the shapes imparted thereto.

Figure 4 shows the front portion of an extruder device D according to the present invention. The following description relates principally to the characteristics by which the device D differs from the device 1 of the prior art.

The device D also comprises an extrusion aperture 4 (hatched in the drawing for greater clarity) which is annular, as in the device 1 of the prior art. This aperture 4, however, has a substantially larger outside diameter, for other given characteristics of the hose to be produced, than the aperture 4 of the device 1 of the prior art.

More specifically, the aperture 4 is of a size such as to produce a hose having a wall thickness substantially equal to the thickness of the normal hose plus the thickness of a protective sleeve to be fitted on the hose.

The front portion of the device D and, more specifically, the flat front surface which contains the extrusion aperture 4 has two movable dies or obturators 5. The two obturators 5 are movable parallel to the front surface in the directions indicated by the double arrows 7. In the drawing, they are shown in continuous outline in the retracted positions 5a and in broken outline in the advanced positions 5b. As can be seen, the portions of the two obturators 5 which face towards the extrusion aperture 4 have semicircular concave profiles.

Once they have been brought close together, in practice, the two obturators 5 thus reduce the outside diameter of the extrusion aperture 4. Clearly, in fact, in the advanced position 5b, the two obturators 5, together with the central body 8, define an extrusion aperture 4 having a wall thickness smaller than that of the extrusion aperture 4 when it is not obstructed by the obturators 5. Naturally, the obturators 5 are of a size such as to define a desired wall thickness of the hose and, more specifically, the wall thickness of a normal, or unprotected, hose.

Clearly, therefore, the device D can be used to produce connecting hoses of differentiated wall thickness. In fact, it suffices to keep the obturators 5 in the advanced positions 5b during the extrusion of the portions of the hose in which it does not need protection and to move the obturators 5 to the retracted positions 5a for the portions of the hose in which it needs protection.

In some embodiments having obturators 5 and extrusion apertures 4 of given shapes such as, for example, that

shown by way of example in Figure 4, the hose produced may have undesirable imperfections. In fact, when the obturators 5 are in a position intermediate the advanced position 5b and the retracted position 5a, projections or ribs form on the outside surface of the extruded hose. These projections or ribs are undesirable.

An embodiment of the device according to the present invention which can extrude a hose having a uniform surface without ribs will now be described. In Figure 5, in which only the area relating to the extrusion aperture is shown, parts and elements already described with reference to Figure 4 have again been given the same reference numerals and/or letters. As can be seen from Figure 5, the extrusion aperture 4, which is hatched, is not annular but has three projections 9 on its outer boundary, facing towards the central body 8.

These projections 9, which will be referred to below as wedges, are tapered and of a length such as to be spaced from the central body 8 by a distance equal to the desired thickness of the normal or unprotected wall of the hose. In this embodiment, there are three obturators 5 each of which therefore affects a 120^{o} portion of the extrusion aperture 4. In other respects, the obturators 5 are substantially similar to the corresponding obturators 5 shown in Figure 4.

The obturators 5 are of a size such that, in the advanced positions 5b they extend as far into the extrusion aperture 4 as the wedges 9 and, as can be seen from the drawing, define a circular extrusion aperture of reduced wall thickness. Naturally, the normal or unprotected hose is extruded in this

condition. When it is necessary to extrude a protected portion of hose, the obturators 5 are moved to the retracted positions 5a. In these positions, as can be seen, the extruded hose has the larger diameter desired for the protected portions of hose and defined by the unobstructed extrusion aperture 4. Clearly, in these portions, the extruded hose does not have a continuous cylndrical surface but has three grooves parallel to its axis, produced by the wedges 9. However, since these grooves are of very limited width or radial extent, for protection purposes they in no way compromise the advantages conferred by the increased thickness of the hose. This method, however, achieves the advantage of completely eliminating undesired ribs or projections. In fact, in the intermediate portions of hose, there is a gradual transition from the smaller diameter to the larger diameter of the extruded hose whilst the grooves, which initially are absent, gradually become deeper.

The subsequent steps are exactly the same as those described above with reference to the prior art. The extruded hose is then cut, formed and subsequently vulcanized. The present invention may also clearly be used to extrude hoses of materials other than rubber, for example, the materials cited above in the description of the prior art.

Figure 2 shows a connecting hose T of reinforced rubber C, formed by means of the device D according to the present invention. As can be seen, this hose T has a portion S having a wall thickness greater than the normal wall thickness of the hose T. Clearly, the effect achieved is identical to that obtained by

fitting a protective sleeve P according to the prior art.

The method of the present invention has several advantages in comparison with the prior art, however. Since the protective portion S is integral with the hose T, it is clearly impossible for it to move, and a disadvantage of the prior art is thus eliminated. Moreover, the hose T protected according to the invention is produced in a single extrusion step substantially similar to the extrusion step for normal connecting hoses, in a fairly simple manner, completely eliminating the need for difficult and expensive additional protection steps.

According to an alternative embodiment, the device D advantageously has, for each obturator 5, an outlet aperture 6 through which the material G admitted to the device D can be extruded.

It should be noted that, in the extrusion process, the hose emerging from the extrusion aperture 4 expands slightly immediately after it has been extruded. This expansion is due to the fact that the extrusion takes place under pressure.

Because of this phenomenon, the extrusion aperture 4 is formed with dimensions slightly smaller than those of the hose to be produced. Since the obturators 5 in practice "choke" the extrusion aperture 4, that is, they reduce the area through which the extrusion actually takes place, they bring about an increase in the pressure within the device D. Clearly, this increase in pressure would undesirably alter the extrusion conditions affecting the diameter of the

extruded hose.

The outlet apertures 6 which are also shown hatched, since extruded material G also emerges therefrom, have the purpose of eliminating this problem. As can be seen from Figure 4, the two apertures 6 are in fact blocked by the obturators 5 when the latter are in the retracted positions 5a. When the obturators 5 are brought to the advanced positions 5b, they open the holes 6 through which the extruded material G therefore emerges.

The apertures 6 are of a size such that their areas correspond to the area of the extrusion aperture 4 which is blocked by the two obturators 5 in their advanced positions 5a. This measure thus leaves the total area through which the extrusion takes place unchanged both when the obturators 5 are in the retracted positions 5a and when the obturators 5 are in the advanced positions 5b.

The pressure within the extruder device D thus remains substantially unchanged and the extrusion therefore takes place evenly and in a controlled manner.

Naturally, alternative embodiments of the device D may be formed by changing the number, the arrangement and the shapes of the obturators 5. For example, it might be desired to form a hose with a wall having a greater thickness only in a portion of its annular cross-section. It is also possible to form hoses having shapes other than cylindrical.

In particular, an alternative embodiment of the present invention similar to the embodiment described by way of

example with reference to Figure 4 will now be described with reference to Figure 6. Parts and elements of Figure 6 which have already been described with reference to Figure 4 have again been given the same reference letters and/or numerals.

In this case, the specific embodiment described has the advantage that is is very easy to put into effect whilst eliminating the problem of the formation of undesired ribs during transition stages of the extrusion.

As can be seen from Figure 6, the structure of the extruder device D is substantially similar to that shown in Figure 4. The difference is essentially in the shape of the extrusion aperture 4. The extrusion aperture 4 has a substantially elliptical or oval external boundary. The internal boundary, however, is of a regular shape, that is, substantially circular. When the obturators 5 are in their advanced positions 5b, the extruded hose thus has a small diameter and a uniform, annular cross-section. When the obturators 5 are brought to their retracted positions 5a, however, the extruded hose has an increased wall thickness substantially in two diametrally-opposed regions of its cross-section.

Clearly, the advance or retraction of the obturators 5 does not give rise to the formation of undesired ribs, since the connection between the extrusion aperture 4 and the obturators 5 never gives rise to cracks or sharp angles.

This embodiment thus enables a hose to be produced with an increased wall thickness in most of its

cross-section, whilst having considerable structural simplicity. Clearly, however, the presence of protected portions of hose in which the wall thickness remains substantially equal to the thickness of the unprotected hose means that, during the bending, that is, the forming of the connecting hoses, it is necessary to take the orientation of the hose into consideration so that the parts which are most subject to the risk of wear in use actually correspond to the portions of hose having increased thickness.

Naturally, the principle of the invention remaining the same, the details of construction and forms of embodiment may be varied widely with respect to those described and illustrated, without thereby departing from the scope of the present invention.

CLAIMS

1. An extruder device (D) for producing a connecting hose, particularly for use in internal combustion engines for motor vehicles, comprising a substantially annular extrusion aperture (4), characterized in that it comprises obturator means (5) which are movable at least between first, retracted positions (5a) and second, advanced positions (5b), and which enable material (G) to be extruded through the extrusion aperture (4) in the plastic state in the form of hoses with portions of wall having different thicknesses according to the positions of the obturator means (5).

2. A device (D) according to Claim 1, characterized in that the obturator means (5) can vary the outside diameter of the hose extruded by the device (D) according to their positions (5a, 5b).

3. A device (D) according to Claim 2, characterized in that the obturator means (5) can adopt advanced positions (5b) in which the extruded hose has a first outside diameter and retracted positions (5a) in which the extruded hose has a second outside diameter larger than the first outside diameter.

4. A device (D) according to Claim 3, characterized in that the obturator means comprise at least two obturators (5) on a surface of the device (D) in which the extrusion aperture (4) is formed, the portions of the obturators (5) which face towards the extrusion aperture (4) having substantially circular, concave profiles.

5. A device (D) according to Claim 4, characterized in that the extrusion aperture (4) has an elongate, substantially eliptical external profile when the obturators (5) are in the retracted positions (5a), the external profile assuming a substantially circular shape when the obturators (5) are in the advanced positions (5b).

6. A device (D) according to Claim 4, characterized in that the extrusion aperture (4) has an external profile having projections (9) facing inwardly of the extrusion aperture (4) and disposed at points of the extrusion aperture (4) where the obturators (5) are disposed alongside each other in the advanced positions (5b).

7. A device (D) according to Claim 6, characterized in that the projections (9) are short and tapered.

8. A device (D) according to Claim 7, characterized in that the projections (9) are substantially trapezoidal.

9. A device (D) according to Claim 8, characterized in that the portions of the projections (9) which face towards the extrusion aperture (4) have substantially circular concave profiles.

10. A device (D) according to any one of Claims 6 to 9, characterized in that it comprises three obturators (5) and three projections (9).

11. A device (D) according to any one of the preceding claims, characterized in that the surface has at least one further aperture (6) for the extrusion of

the material (G), the further aperture (6) being positioned in a manner such that it is blocked and opened selectively according to the positions (5a, 5b) of the obturator means (5).

12. A device (D) according to Claim 11, characterized in that the further aperture (6) and the obturator means (5) are disposed and shaped in a manner such that, when the obturators are in the advanced positions (5b), they open the further aperture (6) and, when the obturator means (5) are in the retracted positions (5a), they block the further aperture (6).

13. A device (D) according to Claim 12, characterized in that the further aperture (6) and the obturator means (5) are disposed and shaped in a manner such that the combined areas of the extrusion aperture (4) and of the further aperture (6) through which the material (G) is extruded, remain substantially unchanged when the obturator means (5) are in the advanced and retracted positions (5b, 5a).

14. A device (D) according to any one of Claims 11 to 13, characterized in that the further aperture (6) and the obturator means (5) are disposed and shaped in a manner such that the pressure of the material (G) within the device (D) during extrusion remains substantially unchanged regardless of the positions (5a, 5b) adopted by the obturator means (5).

15. A device (D) according to Claim 14, characterized in that it comprises a further aperture (6) associated with each obturator (5).

16. A method of extruding hoses having different wall

thicknesses, extruded by means of an extruder device (D) according to any one of Claims 1 to 15, characterized in that it comprises the following steps:

- keeping the obturator means in the advanced positions (5b) for portions of the hose in which it is to have a first wall thickness,

- keeping the obturator means in the retracted positions (5a) for portions of the hose in which it is to have a second wall thickness greater than the first thickness.

17. A connecting hose for use in internal combustion engines of motor vehicles, having portions of different wall-thicknesses, produced according to the method of Claim 16.

18. An extruder device substantially as hereinbefore described with reference to and as illustrated in Figure 4.

19. An extruder device substantially as hereinbefore described with reference to and as illustrated in Figure 5.

20. An extruder device substantially as hereinbefore described with reference to and as illustrated in Figure 6.

21. A method of extruding hoses substantially as hereinbefore described with reference to and as illustrated in Figure 4.

22. A method of extruding hoses substantially as hereinbefore described with reference to and as illustrated in Figure 5.

23. A method of extruding hoses substantially as hereinbefore described with reference to and as illustrated in Figure 6.

24. A connecting hose produced according to the method of any of claims 21 - 23.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report) -17-

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Relevant Technical Fields

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(ii) Int Cl (Ed.5) B29C (47/22, 47/12) F16L (11/12)

Search Examiner
MR T M JAMES

Date of completion of Search
16 DECEMBER 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ON-LINE DATABASES: WPI

Documents considered relevant following a search in respect of Claims :-
1 TO 24

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1149423	(CARLO) see page 2 lines 42 to 66	1 to 4, 16 and 17 at least
X	GB 1076326	(RHONE-POULENC) see the figures	1 to 4, 16 and 17 at least
X	US 5110529	(TOKAI KOGYO) see column 4 line 65 to column 5 line 8	1, 11 to 15, 16 and 17 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).